

III. REMARKS

In the Final Office Action, claims 1-12, 14-17, and 26-28 were rejected under 35 U.S.C. 103 as being unpatentable over Figs. 1 and 2 of Applicant's Prior Art (APA) in view of Takahashi (US 5634204) for reasons set forth in the Action. Claims 13, 18-25 and 29-32 were rejected over various combinations of APA and Takahashi, with Jones (US 6531985), Edvardsson (US 6334048), and Chang (US 5692019) for reasons set forth in the Action.

With respect to the rejections under 35 U.S.C. 103, the following argument is presented to distinguish the claimed subject matter from the teachings of the cited art, thereby to overcome the rejections, and to show the presence of allowable subject matter in the claims.

A purpose of the claimed subject matter is to compensate for changes in polarization of a received signal (present specification, page 2 at bottom paragraph, page 4 at lines 19-20). There is a switching between the signals received at each of two antennas so that a first part of a piece of transmitted information is received with the first antenna and a second part of the piece of transmitted information is received with the second antenna (specification, Page 5 at lines 7-11). The time during which each antenna is used in receiving RF signals may be chosen, by operation of the switching process, to enable reception of each of a sequence of symbols by both of the antennas (specification, page 10 at lines 3-6). This feature of the invention accomplishes the desired compensation for changes in polarization of the received signal.

In order to emphasize this feature of the invention, thereby to distinguish between the claims and the cited art, claims 31-32 are amended to emphasize that the switching time of each of the first and the second antennas enables reception of a single symbol by both of said first and said second antennas to compensate for changes in polarization of a received signal. This aspect of the invention is not disclosed or suggested in any of the cited references. For example, Takahashi selects a time for switching based on a threshold of received signal level (Fig. 3). Chang selects a time for switching based on a

set of values of signal strength measured over various periods of time, such as one symbol period or a few symbol periods (col. 2 at lines 31-62).

By way of further argument, it is noted that Figure 2 of APA discloses a polarization diversity antenna switching. Figure 2 presents an example of a polarization diversity receiver, which has two antennas. Each antenna has different polarization properties to receive a signal. Each antenna is connected to its own RF block. The RF blocks, in turn, are connected to A/D converters. However, Figure 2 teaches two separate receiver chains (see Figure 2 blocks 111a, 112a, and 111b, 112b). Both chains produce two digitized signals S1 and S2. They are processed further in the DSP block. Figure 2 thus needs many components, i.e. two receiver chains. Furthermore the teaching of Figure 2 is absolutely not able to produce a linearly combined interleaved analog signal at all. The teaching of Figure 2 can only simply digitally combined signals. Furthermore, there is no disclosure of ways to digitally enhance the polarization properties of the signals. Accordingly, this arrangement does not result in good signal reception quality because polarization properties are not realized for use in the teaching of Figure 2.

Takahashi is aimed at polarization diversity antenna switching. Takahashi has an antenna switch. However, the fundamental difference between Takahashi and the present invention is the way the switching and "combining" of the signals are accomplished. Takahashi does not (linearly) combine interleaved signals so that an output signal is produced using, at a given possible time, both received analog signals. In Takahashi either antenna A or antenna B signal is receiving a signal. The selection is based on a switch controlled by two thresholds (mean reception quality, and reception quality at the moment). Furthermore, ways to digitally enhance the polarization properties of the signals are not disclosed.

The recited claims advantageously linearly combine the interleaved analog signals, digitizes and samples the combination, and uses polarization optimization in order to further combine the digitized signals. The subject matter claimed better utilizes

polarization for producing the final output signal. Furthermore, the claimed subject matter is better suited for reception of signals of many different spectra.

This argument is believed to show that the claims are is now clearly inventive over any combination of Figure 2 and Takahashi.

Furthermore, as noted in the previous response, the APA, considered alone or in combination with Takahashi, does not teach the foregoing linear combination of sampled signal components. Present Fig. 2 is limited to disclosing only that both signals are property combined. But there is no teaching of the production of one combined signal, which is a linear combination of at least two sampled signal components, as is set forth in claims 1 and 15, as now amended.

More precisely, present Fig. 2 discloses a known polarization diversity method that serves to increase the quality of a received signal. Fig. 2 presents a polarization diversity receiver 200 having two antennas 101a and 101b with different polarization properties, which are used to receive a signal. Each antenna is connected to its own RF block, and the RF blocks 111a, 111b are, in turn, connected to A/D converters 112a, 112b. The digitized signals corresponding to the signal component received with the first antenna 101a, and corresponding to the signal component received with the second antenna 101b, are complex valued signals that are processed further in the DSP (digital signal processor) block 201. When polarization diversity is employed, either one of the received signals is used in the reception, or both received signals are properly combined and used in the reception.

The foregoing cited passages of the art does not disclose the feature of the claims wherein the linear combination is combined so that a quality of combined signal corresponding to each set of coefficient values is at a certain time at least equal to a quality of the one of the sampled signals having the best quality.

Examples of the above feature are presented in the present specification, considered with present Fig. 3, which provide descriptions of various embodiments. In Fig. 3, attention is directed to blocks 306 and 307. Furthermore Fig. 4, at blocks 402 and 403, describes further embodiments of these features. It is noted that both figures describe various embodiments of the invention, and are not APA.

The claims depending from claims 1 and 15 are believed to be distinguishable from the cited art for the reasons set forth above for claims 1 and 15.

The combined teachings of APA and Takahashi, which together constitute the basic source of rejection of the claims, actually present a system and methodology which is very much different from the claims. Takahashi teaches (Abstract) that one switches antennas when the received signal level drops below a threshold, such that one switches to the antenna providing the stronger of two signals. The Abstract specifically states that the switching of antennas is not made when the received signal level falls below a second threshold value to prevent unnecessary antenna switching.

In contrast, in the claims, antenna switching is made continually, and at the ends of intervals of signal propagation that are short compared to the durations of parameters of the signal format. This is taught in the present specification on page 9 at line 34, on page 10 at lines 3-16, and on page 12 at lines 4-24. As examples of such parameters of the signal format, the specification refers to terms such as "bit", "epoch", "symbol" and "chip sequence". Usually, switching of antennas may occur within an interval of time equal to the duration of one of the foregoing parameters, but may also occur numerous times within the duration of one of the foregoing parameters. It is important to note that the antenna switching goes on continually, and does not occur in the manner of Takahashi wherein use of a single antenna may be maintained for an extended period of time during which there is a strong signal that one of the antennas.

Takahashi et al. does not teach to produce a combined signal as a linear combination of a first signal received from a first antenna and a second signal received from a second antenna, said linear combination being formed using complex-valued coefficients. A complex-valued coefficient (having a real part and an imaginary part) is able to modify both amplitude and phase of a sampled signal component. Therefore, in the solution according to the present invention, there is no need for adjustable delay lines to adapt phases of different signal components to be compatible with each other like e.g. in Admitted Prior Art, page 3, lines 19-27 of the present specification.

The amended independent claim 1 recites the above-mentioned features:

- producing at least one combined signal that is a linear combination of at least the first sampled signal component and the second sampled signal component, and
- selecting at least one set of complex values for coefficients of the linear combination so that a quality of the combined signal corresponding to each set of coefficient values is at a certain time at least equal to a quality of the one of the first sampled signal component and the second signal component having the best quality.

The amended independent claim 15 recites the above-mentioned features:

- a combination element arranged to produce at least one combined signal that is a linear combination of at least the first sampled signal component and the second sampled signal component, and
- a selection element arranged to select at least one set of complex values for coefficients of the linear combination so that a quality of the combined signal corresponding to each set of coefficient values is at a certain time at least equal to a quality of the one of the first or second sampled signal components having the better quality.

In page 12 of the Office Action the examiner refers to part C of figure 3 of Takahashi and says that the part C of figure 3 would represent a linear combination of at least two sampled signal components from a first antenna and a second antenna.

The applicant respectfully presents the following analysis about the solution disclosed by Takahashi.

The signal shown in the part C is a control signal that shows/determines which one of the first and the second antennas is currently used. In the solution disclosed by Takahashi, the control signal is not produced using a linear combination of a first signal and a second signal received from the first antenna and the second antenna, respectively. Equations 1 and 2 of Takahashi do not represent forming a linear combination of signals received from different antennas.

Equation 1 of Takahashi represents a well-known first-order infinite impulse response (IIR) low-pass filter that can be used for obtaining a mean level (a time average) of a time varying quantity. In the solution of Takahashi, the IIR low-pass filter is one alternative to obtain a mean level of an instantaneous signal level of a signal received from antenna A or from antenna B. An instantaneous signal level can be, for example, an envelope of a signal.

Correspondingly, Equation 2 represents a well-known finite impulse response (FIR) low-pass filter that can be used for obtaining a mean level of a time varying quantity. In the solution of Takahashi the FIR low-pass filter is one alternative to obtain a mean level of an instantaneous signal level of a signal received from antenna A or from antenna B.

In the solution of Takahashi an input quantity that is fed into an IIR- or FIR-filter consists of successive samples of either the instantaneous signal level of the signal received from antenna A or the instantaneous signal level of the signal received from

antenna B. In the solution disclosed by Takahashi, a first mean level is produced for the signal received from antenna A, and a second mean level is produced for the signal received from antenna B (see e.g. column 4, rows 32-43 and figure 3). In other words:

$$M1 = \text{LPF}(\text{ENV}(S_a)) \text{ and } M2 = \text{LPF}(\text{ENV}(S_b)),$$

where M1 denotes the first mean level, M2 denotes the second mean level, S_a denotes the signal received from antenna A, S_b denotes the signal received from antenna B, $\text{ENV}(-)$ denotes an operation for obtaining an instantaneous signal level (e.g. an envelope), and $\text{LPF}(-)$ denotes low-pass filtering.

A value of the above-mentioned control signal shown in the part C of Fig. 3 of Takahashi is changed from a first value that selects antenna A to a second value that selects antenna B as a response to a situation in which the instantaneous signal level from antenna A ($\text{ENV}(S_a)$) goes under a value of a scaled version of the first mean level ($a * \text{LPF}(\text{ENV}(S_a))$). The value of the above-mentioned control signal shown in the part C is changed from the second value that selects antenna B to the first value that selects antenna A as a response to a situation in which the instantaneous signal level from antenna B ($\text{ENV}(S_b)$) goes under a value of a scaled version of the second mean level ($a * \text{LPF}(\text{ENV}(S_b))$), column 4, rows 32-43 in Takahashi.

The above-analyzed procedure is a totally different procedure than forming a linear combination of signals received from antenna A and antenna B using complex-valued coefficients. An example of linear combination would be $C1 * S_a + C2 * S_b$, where $C1$ and $C2$ are the complex-valued coefficients of the linear combination and S_a and S_b denote the signals received with antenna A and with antenna B, respectively,

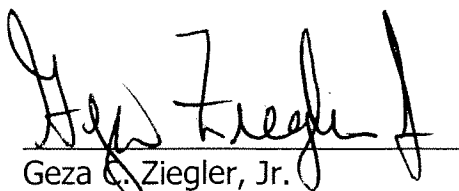
Neither APA teaches to produce a combined signal as a linear combination of a first signal received from a first antenna and a second signal received from a second antenna, the linear combination being formed using complex-valued coefficients.

The independent claims 1 and 15 are amended to emphasize the foregoing distinctions between the claims and the art cited by the examiner. Various ones of their respective depending claims are amended to conform to the amended independent claims. Accordingly, the amendments to the present claims are believed to overcome the foregoing rejections, and to show the presence of allowable subject matter in the claims.

For all of the foregoing reasons, it is respectfully submitted that all of the claims now present in the application are clearly novel and patentable over the prior art of record, and are in proper form for allowance. Accordingly, favorable reconsideration and allowance is respectfully requested. Should any unresolved issues remain, the Examiner is invited to call Applicants' attorney at the telephone number indicated below.

The Commissioner is hereby authorized to charge payment of \$1810.00 for the three-month extension of time and the RCE fee, as well as for any other fees associated with this communication or credit any over payment to Deposit Account No. 16-1350.

Respectfully submitted,


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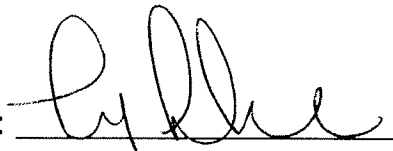
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